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Revealed Comparative Advantage in Forest Products Trade.

Jacques, Romain

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# WORKING PAPER

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## REVEALED COMPARATIVE ADVANTAGE IN FOREST PRODUCTS TRADE

by

ROMAIN JACQUES

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Policy, Economics and International Affairs Directorate

Natural Resources Canada - Canadian Forest Service



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### Revealed Comparative Advantage in Forest Products Trade

by  
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## SUMMARY

This working paper deals with international trade in forest products. It briefly explains the theory of comparative advantage and the theory of competitiveness. Then it presents various ways of measuring comparative advantage, including the one used in this study: the index of revealed comparative advantage (RCA). RCA indexes were calculated for the forest product trade of 124 countries over a period of 21 years, from 1970 to 1990.

Of the 124 countries that were analysed, 37 have a revealed comparative advantage in forest products, that is to say, they are net exporters of forest products and therefore have a positive RCA index. Among the industrialized countries, Finland is most dependent on exports of forest products. Between 1988 and 1990, Finland's net average exports of forest products were \$75.70 per \$1000 of Gross National Product (GNP). Although this level is high for a developed country, it represents a historic low for Finland.

In Canada and Sweden, net exports of forest products are increasing at the same rate as the rest of the economy. The average RCA index between 1988 and 1990 was 42.5 for Sweden and 33.0 for Canada. In Canada, the growth in net exports of forest products was accompanied by an increase in wood harvesting from 117 million cubic metres in 1970 to 174 million cubic metres in 1990, or an annual increase of two percent. Sweden, on the other hand, succeeded in maintaining the relative position of net exports of forest products in its economy while reducing its harvesting from 56 million cubic metres in 1970 to 49 million cubic metres in 1990. This feat was made possible by a change in the composition of Swedish forest-product exports. Exports of low value-added products such as roundwood, certain types of lumber, and wood pulp were gradually replaced by high value-added products such as paper.

Portugal saw its RCA index rise over the 1980s. Based on its plantations, net exports of forest products increased faster than GNP. It is interesting to note that, despite its large surplus in wood pulp, Portugal ran a deficit (or was a net importer) in paper with an RCA index of -3.1 in 1988-90.

Based on its plantations of rapidly growing *Pinus radiata*, the Chilean forest industry developed much more rapidly than the rest of its economy. The pulp wood, lumber and, especially, wood pulp sectors grew at phenomenal rates. On a world scale, the Chilean forest industry is relatively small; however, net exports of forest products are as important for the Chilean economy as they are for the Canadian economy.

A number of countries with tropical forests experienced steep declines in their RCA indexes, or in other words, declines in net exports of forest products per dollar of GNP. These countries were Gabon, the Congo, Côte d'Ivoire, Ghana, Cameroon, Honduras and the Philippines. In some cases, the declining RCA indexes were accompanied by decreases in the amounts produced, while in other cases, declining prices imply that the species exported were of lesser quality than



previously. The entire picture suggests that the forests of these countries were over-exploited in the past, at least in regard to the most valuable species.

In the early 1970s, Indonesia exported roundwood without any processing. The Indonesian government decided to change this and instituted an industrial development policy. It gradually closed the door on exports of roundwood in order to encourage domestic processing of this resource. The about-face is now complete since Indonesia hardly exports any roundwood any more and several years ago became the world's largest exporter of plywood. As a result of this change in the composition of its exports, the value in real terms (adjusted for inflation) of Indonesia's net exports of forest products increased by a factor of 9.6, while the wood harvest only increased by a factor of 2.0.

Apart from the United States, there has been a clear reduction in dependence on imported forest products in the G7 countries that import them, namely Japan, Germany, France, the United Kingdom and Italy. There could be two reasons for this: first, the consumption of forest products may be increasing less quickly than consumption of other goods and services so that imports of forest products per dollar of national income have been falling over time, or second, the forest industry in these countries may be producing more, thus reducing the need for imports. The result for Canada is that, in the future, these countries will need larger increases in GNP in order to generate the same increases in imports of forest products. Paper, however, is an exception to the rule; in general, these countries are importing more paper per \$1000 of GNP.

Fourteen countries have comparative advantages in the combined sector of pulp and paper. All these countries, with the exception of four, have heightened their comparative advantages in paper in order to supply the needs of the main countries that are net importers of forest products. The four countries that have not increased their comparative advantages in paper production are Swaziland, Canada, New Zealand and Norway. It is difficult to understand why countries that are as well endowed with capital and coniferous forests as Canada, New Zealand and Norway have failed to increase their comparative advantages in the paper sector. The determining factors in their comparative advantages would have to be studied in order to answer this question.



## INTRODUCTION

This working paper deals with international trade in forest products. It briefly explains the theory of comparative advantage and the theory of competitiveness. Then it presents various ways of measuring comparative advantage, including the one used by Bonnefoi and Buongiorno (1990) and by this study: the index of revealed comparative advantage (RCA). RCA indexes were calculated for the forest product trade of 124 countries over a period of 21 years, from 1970 to 1990. They are presented in the form of graphs for 48 countries and tables for 124 countries for the years 1970-72 and 1988-90. A short analysis summarizes the main trends revealed by the RCA indexes.

## THE THEORIES OF COMPARATIVE ADVANTAGE AND COMPETITIVENESS

The theory of comparative advantage attempts to explain what determines trade and commerce between various countries and, hence, their specializations. It was first advanced by David Ricardo (1817), at a time when economics was still in its infancy. It replaced the theory of absolute advantage, developed by Adam Smith (1776), and remains today the cornerstone of the theory of international trade.

A country has an absolute advantage if it produces at a lower cost than another country or all other countries. Absolute advantages in the production of particular commodities could be due, for example, to an abundance of particular inputs, to cutting-edge technologies that are more efficient, or to favourable locations relative to markets.

The theory of comparative advantage says basically that, even if a country has an absolute advantage in *all goods* that it consumes, it nevertheless benefits from specializing in the production of goods for which its costs are *relatively* lower in comparison with foreign costs, that is to say, those in which it has a comparative advantage. The portion of these goods that cannot be consumed domestically is then traded for those whose relative cost would be higher and which it allows to be produced abroad. Specialization and trade enable all countries to produce the maximum amount of goods.

The theory of comparative advantage is based on a number of specific assumptions, of which the main ones are the following (Gouin and Proulx [1992]):

- 1) markets for the factors of production within a country are perfectly competitive, implying total mobility of these factors among the sectors of production;
- 2) the factors of production are available in fixed, homogeneous amounts and cannot leave the country;
- 3) the production functions have complementary factors and differ for the same product from one country to another;
- 4) the factors of production are fully employed and returns to scale are constant.



## *A simple illustration of the theory of competitive advantage*

To illustrate the theory of comparative advantage, take the simple example of two countries, X and Y, and two commodities, A and B. Suppose that country X has an absolute advantage at producing commodity A; it is capable of producing 100 units of commodity A with 100 units of labour, while country Y only produces 60 units of commodity A with 100 units of labour. Suppose, in addition, that country X also has an absolute advantage at producing commodity B; it is capable of producing 100 units of commodity B with 100 units of labour, while country Y produces only 80 units of commodity B with 100 units of labour. Country X has an absolute advantage in all the commodities it consumes and a comparative advantage at producing commodity A. According to the theory, it is better for both countries if country X specializes in producing commodity A and country Y specializes in producing commodity B.

Without specialization and trade, the two countries would be in autarky and would have to provide for the needs of their own populations. Suppose, in order to simplify, that both countries have 100 units of labour and the people of both countries want to consume 40 units of commodity B and as much as possible of commodity A. Country X would devote 40 units of labour to the production of 40 units of commodity B and would produce 60 units of commodity A (by the rule of three and assuming constant efficiencies of scale and full employment). Country Y would use 50 units of labour to produce 40 units of commodity B and would produce 30 units of commodity A. Total production would therefore be 90 units of commodity A and 80 units of commodity B.

|             | Country X | Country Y | Total |
|-------------|-----------|-----------|-------|
| Commodity A | 60        | 30        | 90    |
| Commodity B | 40        | 40        | 80    |

If there is specialization and trade, it is better for country Y to produce the 80 units of commodity B needed for the people of both countries, thus freeing the labour units in country X to produce commodity A, i.e., to produce where it has a comparative advantage. Country X would produce 100 units of commodity A and no units of commodity B, while country Y would produce 80 units of commodity B and no units of commodity A. Total production would be 80 units of commodity B and 100 units of commodity A, or 10 more units than under the previous system. These additional units would be distributed between the two countries when country X exchanges some commodity A for some commodity B from country Y.

|             | Country X | Country Y | Total |
|-------------|-----------|-----------|-------|
| Commodity A | 100       | 0         | 100   |
| Commodity B | 0         | 80        | 80    |



In reality, these assumptions rarely fully exist. High unemployment in certain sectors of production and vacant positions in others indicate that the skills of the labour force are not always sufficient to ensure perfect mobility between sectors. The internationalization of financial markets ensures high mobility of capital. Multinational corporations make the same technologies available in different countries and the production functions are quite uniform. Full employment is rarely achieved and returns to scale are often seen. Nevertheless, the theory of comparative advantage retains a certain ability to explain the specialization of countries in the production of particular goods and the trade among them for some of these goods.

The theory of comparative advantage has the merit of placing international trade in the overall perspective of the production of all goods in all countries. It explains how a country could benefit from importing goods for which its own production costs are lower (see the illustration on the previous page). The theory of absolute advantage, on the other hand, claimed that it was only necessary for a country to have lower production costs in order to close the door on imports.

The concept of competitiveness is more recent and comes to us from the administrative sciences. The sudden popularity of the term has generated a rash of definitions. Ash and Brink (1992) counted no fewer than 14. Competitiveness is a broad concept that has been used to describe performance at three levels of economic analysis: companies, industries and countries. Companies are generally considered competitive if they are able to generate profits. Among industries, competitiveness is generally defined as the ability of an industry to compete with other industries in the same country (for instance, the lumber industry competes with the brick industry in construction materials) or with the same industry in other countries (for instance, the Canadian newsprint industry competes with the Scandinavian newsprint industry in European markets). Among countries, competitiveness is often defined as a country's ability to provide a high standard of living for its citizens. A country's competitiveness depends on the competitiveness of the industries on its soil, just as the competitiveness of an industry depends on the competitiveness of the companies that compose it.

Like the definition of competitiveness itself, the indexes that measure it vary depending on the level of economic analysis. Since the purpose of this study is to measure the performance of the forest industry in various countries, we will explain the concept of competitiveness on an industrial level.

On an industrial level, we defined competitiveness as the ability of an industry to compete. Coffin et al. (1993) have proposed a more precise definition that amounts to the ability of an industry to maintain or increase its market share while remaining profitable. The performance indicators of competitiveness that these authors advocate are therefore shares of domestic and foreign markets as well as measures of profitability. Market share reflects competitiveness when the market is competitive, but it is easily affected by trade barriers. Hazeldine and Feeley (1991) use competitiveness indicators that do not change in the presence of trade barriers, namely productivity indexes and comparisons of production costs and selling prices. According to them, an industry is competitive if it is more productive than its competitors, that is to say, if it can produce more with less, if it has lower production costs, or if it is able to sell its production at



higher prices than its competitors. The latter statement may seem surprising because, not long ago, the ability to sell at the lowest price was thought to be synonymous with competitiveness. However, it is now recognized that the ability to differentiate your product and develop market niches in order to sell at higher prices than your competitors can be seen as a sign of competitiveness.

The indicators of competitiveness described above conform to the micro-economic theory of companies in competitive market situations. The companies that are most productive and profitable, with the lowest production costs, expand their market shares. This is possible because factors of production, particularly workers, move to companies with a potential for growth. However, when companies are located in different countries, the factors of production generally cannot move. Immobile factors of production change the situation. The theory of international trade based on comparative advantage takes this into account, whereas at first blush the literature on competitiveness does not seem to mention it.

The concept of competitiveness between industries in different countries is somewhat like the theory of absolute advantage. In both cases, the basic idea is to compare the performance of countries in order to determine the flow of trade. The country with lower production costs will necessarily export to the other countries. The theory of comparative advantage warns us against this reasoning. A country might find that its production costs are higher than those of other countries for all the commodities it might choose to produce. Since the factors of production cannot leave this country, it is best to use them to produce goods whose costs are relatively lower. It is also best for other countries if this one concentrates on the area where its relative costs are the lowest, thereby enabling them to specialize as well in their industries that have comparative advantages.

Finally, there is a definition of competitiveness that can be reconciled with the theory of comparative advantage. Sharples (1990) defined competitiveness as a combination of comparative advantages and market distortions. These market distortions can be caused by policies (e.g., the imposition of tariff barriers) or market imperfections (e.g., the existence of natural monopolies). According to this view, comparative advantage is a theoretical concept that explains trade in a world without distortions, while competitiveness refers to what can be observed.

An important corollary to the theory of comparative advantage is that it is not enough to compare the costs of production of a commodity in various countries in order to determine the trade flows in this commodity. Theoretically, the production costs of *all* commodities produced in various countries would have to be compared in order to calculate the comparative advantage of each one and determine trade flows. This comparison should ideally be made when there is no trade between the countries and the differences in production costs between them are most marked, because trade tends to equalize the remuneration of the factors of production and therefore to standardize costs. Since, in reality, trade between countries does exist, it is practically impossible to develop a direct measure of comparative advantage.



## MEASURING COMPARATIVE ADVANTAGE

Despite the difficulty in measuring comparative advantage, many authors have studied the question and have proposed various indicators. Balassa (1965) proposed an index of revealed comparative advantage that divides a country's share of the exports of a particular product by its share of the exports of all products. Scott and Lodge (1984) and D'Cruz and Fleck (1985) used this approach for the United States and Canada respectively, rebaptising the index as the index of revealed comparative advantage for exports (RCAE). The RCAE index is calculated as follows:

$$\frac{\text{country's exports of product A}}{\text{world exports of product A}} \div \frac{\text{country's total exports}}{\text{world exports}} \quad (1)$$

According to Ricardo's logic, the products with comparative advantages should be those accounting for a higher percentage of the country's exports. In Lafay's view (1987), this indicator has, however, one major drawback. It is based on exports alone and therefore paints a one-sided picture of a country's international trade. It is just as important to analyse the structure of a country's imports that reflect penetration of its domestic markets. He therefore suggests using an indicator that assigns equal weight to exports and imports by looking at the balance of trade in various products. His "balance contribution" indicator is based on the belief that, for the country being studied, a uniform distribution of the overall prorated balance for each product reflects a lack of comparative advantage. According to this indicator, an industry has a comparative advantage over other industries when the balance of its products is relatively higher than the balance of trade. This means that, in the case of a country that is a net exporter, an industry with a comparative advantage should run a surplus that is relatively higher than the overall balance of trade; meanwhile, in the case of a net importing country, an industry that runs a deficit that is relatively lower than the overall balance of trade is considered to have a comparative advantage.

The balance contribution indicator is represented by the following formula:

$$cont_i = Z_i - Z_{tot} (X_i + M_i) / (X_{tot} + M_{tot}) \quad (2)$$

in which  $X_i$  and  $X_{tot}$  are respectively the country's exports of product  $i$  and total exports,  $M_i$  and  $M_{tot}$  are respectively the country's imports of product  $i$  and total imports, and  $Z_i$  and  $Z_{tot}$  are respectively the relative balance for product  $i$  and the relative overall balance of trade, calculated as follows:

$$Z_i = 100 (X_i - M_i) / (X_{tot} + M_{tot}) / 2 \quad (3)$$



and

$$Z_{tot} = 100 (X_{tot} - M_{tot}) / (X_{tot} + M_{tot}) / 2 \quad (4)$$

In 1993, Canada exported \$26.2 billion of forest products and imported \$3.9 billion, for a balance of trade of \$22.3 billion in forest products. Its total exports were \$177.5 billion and total imports \$160.1 billion. Canada's relative balance indicator in forest products was therefore 3.31 and its overall relative balance indicator was 2.57. The balance contribution indicator for forest products was 3.08.

Another index that measures revealed comparative advantages (RCA) is the relationship of net exports to national income (Y), or:

$$ACR_i = (X_i - M_i) / Y \quad (5)$$

When the RCA index is positive, it indicates the value of net exports of product i for each dollar of national income. When it is negative, it indicates the value of net imports of product i for each dollar of national income. This index is similar in spirit to the balance contribution indicator because it considers trade in both directions: imports and exports. It has been used by various authors on many occasions. Bowen (1983) sees several reasons to use it.

Bonnefoi and Buongiorno (1990) used this indicator of revealed comparative advantage to analyse international trade in forest products. They reported the average index for the years 1982 to 1984. We will update their results, while extending the number of countries analysed.

## THE DATA

The data for this study were obtained from two main sources: the United Nations Food and Agricultural Organization (FAO) and the World Bank. These two bodies distribute their data banks on diskette with software that makes it possible to extract data. Per capita gross national product in American dollars and population came from the World Bank. The value of exports and imports of forest products in American dollars came from the FAO. Data from both sources were imported and processed using Lotus 1-2-3 version 4.0 for Windows.

The RCA index as calculated for this study is shown in equation (5) multiplied by 1000. In order to obtain net trade, the value of imports was subtracted from the value of exports for the forest product under study. To obtain Gross National Product (GNP), per capita GNP was multiplied by the population of the country. The RCA index was obtained by dividing net trade by the country's GNP.



The data on international trade in forest products covers the years 1961 to 1991 inclusively. The data on GNP cover the years 1970 to 1990 inclusively. We could only calculate RCA indexes for the period covered by both data banks, namely 1970 to 1990. We included all countries with data available for at least one year covered in the study, or 124 countries.

Since East Germany's GNP was not available, the data for Germany pertain only to West Germany. Since the population of Germany as reported by the World Bank is that of the re-united Germany, we took the population of West Germany from the International Monetary Fund (IMF). The FAO combined the data on forest product trade for Belgium and Luxembourg, and in order to be consistent, the socio-economic data from the World Bank was also combined for these two countries. Some countries are called by somewhat different names in the two data banks, as shown below:

| <u>FAO</u> | <u>WORLD BANK</u> |
|------------|-------------------|
| Laos       | Lao, PDR          |
| Syria      | Syrian Arab Rep.  |
| Samoa      | Western Samoa     |

## RESULTS

Table 1 in the appendix shows the revealed comparative advantage (RCA) index for 124 countries on average for 1988-90 and 1970-72 in the main categories of forest products. In continental Europe and Japan, the years 1988 to 1990 were prosperous with real increases in GNP of about 4% for the former and 6% for the latter. In North America and the United Kingdom, the real annual GNP growth rate was 6% in the first quarter of 1988, but it gradually declined until becoming negative (-1%) in the first quarter of 1990, announcing the beginning of the 1991 recession. The years 1970 to 1972 were prosperous in the main industrialized countries, with annual real growth rates in GNP varying between 4% and 7%. The lowest growth rates were in continental Europe and the United States, and the highest in Canada, Japan and the United Kingdom.

The categories of forest products were the same as those used by Bonnefoi and Buongiorno (1990): industrial roundwood, lumber, wood panels, wood pulp, paper, and an aggregate of all forest products.

The index in Table 1 is derived by means of equation (5) multiplied by 1000. It shows the value of net exports (net imports) of forest products in dollars for each \$1000 of GNP in each country. Just as the sum of the net exports of each forest product equals net exports of forest products, the sum of RCA indexes for each forest product equals the RCA index for forest products. Exports and imports and GNP are expressed in American dollars. However, since the RCA index



is a ratio of these two numbers, it becomes a pure number and remains the same regardless of the monetary unit selected.

Of the 124 countries that were studied, 37 have a revealed comparative advantage in forest products. This means that they are net exporters of forest products and therefore have a positive RCA index. In our study, we are going to look primarily at those countries that compete with Canada on the international market for forest products. In order to facilitate the analysis, we grouped these 37 countries into four distinct geographic regions. The first region comprises ten countries in North America and Europe that are economically developed, including Canada, which is also of course a member of the group of the seven most industrialized countries (G7). The three other geographic groups are: 11 countries in Africa, 6 countries in Latin America, and finally 10 countries in Asia and Oceania.

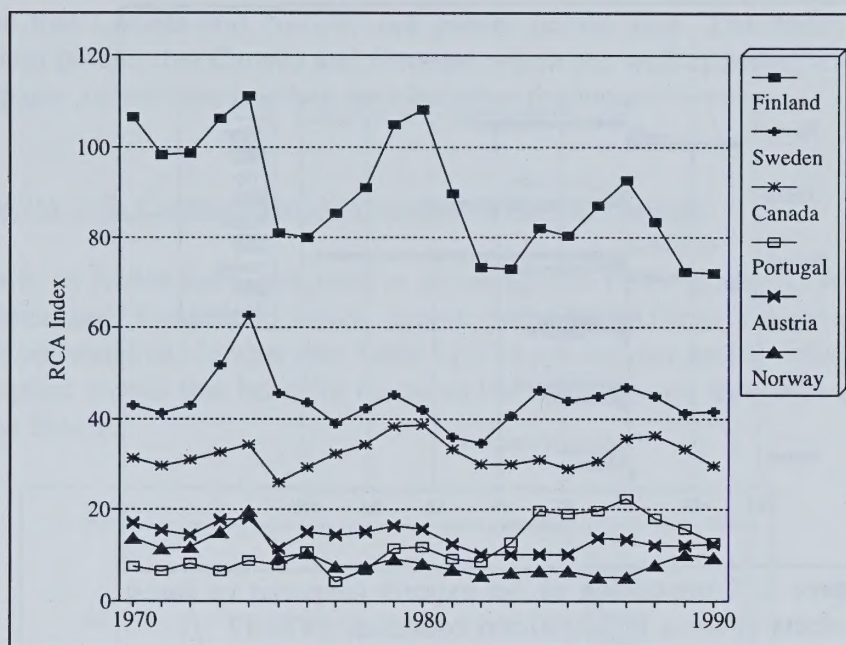
Most countries (86 of the 124) are net importers of forest products and their RCA indexes are negative. We analysed some of these countries, concentrating on OECD countries that are net importers because they have strong economies likely to import large amounts of forest products.

#### The Countries in North America and Europe with Comparative Advantages in Forest Products.

Ten countries in North America and Europe are net exporters of forest products: Finland, Sweden, Canada, Portugal, Austria, Norway, Czechoslovakia,<sup>1</sup> Romania, Yugoslavia,<sup>1</sup> and Poland. When their net exports of forest products are compared with the size of their economies by calculating the index of revealed comparative advantages (RCA), Finland turns out to be most dependent on exports of forest products. Between 1988 and 1990, Finland recorded \$75.70 in average net exports per \$1000 of GNP. Figure 1 shows that although this amount is high for a developed country, it still constitutes a historic low for Finland. In fact, Finland's index lost an average of 1.7 a year between 1970 and 1990. The decline in Finland's RCA index and the violent swings in it (probably related to the changing exchange rate of the national currency) would certainly be an interesting subject for further study. For now, we note that for a developed country, Finland's forest sector occupies a very large place in the national economy.

By contrast, the indexes for Canada and Sweden are relatively stable during the period under study, fluctuating around 40 for Sweden and 30 for Canada. This means that, in both countries, net exports of forest products increased at the same rate as the rest of the economy. The average RCA index between 1988 and 1990 was 42.5 for Sweden and 33.0 for Canada (see Table 1 in the Appendix). In Canada, the increase in net exports of forest products was accompanied by an increase in wood harvesting, which rose from 117 million cubic metres in 1970 to 174 million cubic metres in 1990, for an annual growth rate of 2%. Sweden, on the other hand, managed to maintain the position of net exports of forest products in its economy while reducing its wood harvest, which fell from 56 million cubic metres in 1970 to 49 million cubic metres in 1990. This feat was made possible by a change in the composition of Sweden's exports of forest products. Exports of low value-added products such as roundwood, certain types of lumber, and wood pulp were gradually replaced by high value-added products such as paper (see Figures 2 and 3).





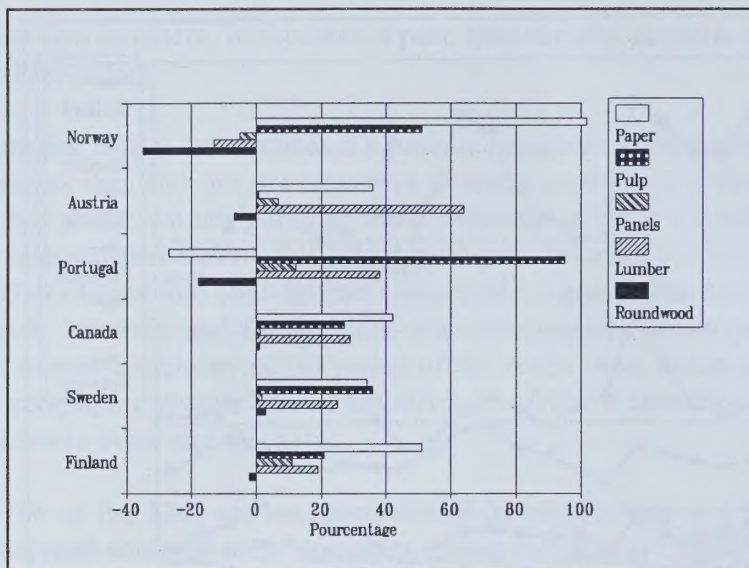
**Figure 1.** RCA index for countries in Europe and North America with comparative advantages in forest products, 1970-1990.

Portugal saw its RCA index increase over the 1980s. Based on its plantations, net exports of Portuguese forest products increased at a faster rate than GNP. We calculated that the RCA index for all Portuguese forest products was 7.3 in 1970-72. Bonnefoi and Buongiorno (1990) calculated it as 14.3 in 1982-84, when it was rising rapidly, and we calculated it again as 15.5 in 1988-90. At that time, as now, the main product was wood pulp, with an RCA index of 10.2 in 1982-84, rising to 15.0 in 1988-90. It is interesting to note that despite its large surplus of wood pulp, Portugal ran a deficit (or was a net importer) in paper with an RCA index of -3.1 in 1988-90.

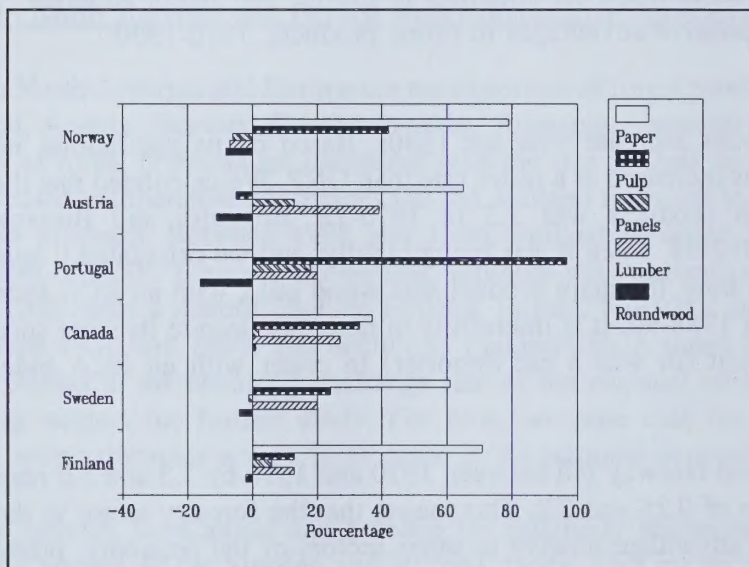
The indexes for Austria and Norway fell between 1970 and 1990 by 3.5 and 3.0 respectively, for an annual average decline of 0.25 and 0.2. This means that the forestry sector in these countries is losing its comparative advantage relative to other sectors of the economy, probably because of greater industrial diversification, and, in Norway's case, the development of North Sea oil.

According to observers, some countries in Eastern Europe, namely Czechoslovakia,<sup>1</sup> Romania, Yugoslavia<sup>1</sup> and Poland, have a promising potential in forestry that was under-exploited in 1990. The RCA index for these countries varied between 1.3 and 5.0 in 1988-90, but might increase over the next decade.

Figures 2 and 3 show the composition of net exports of forest products for the main industrialized countries. Figure 2 shows the composition for 1970-72, and Figure 3 for 1988-90. A comparison of the two figures shows that paper production expanded in Sweden, Finland and Austria at the



**Figure 2.** Composition of net exports (imports) of forest products in some industrialized countries, 1970-72



**Figure 3.** Composition of net exports (imports) of forest products in some industrialized countries, 1988-90

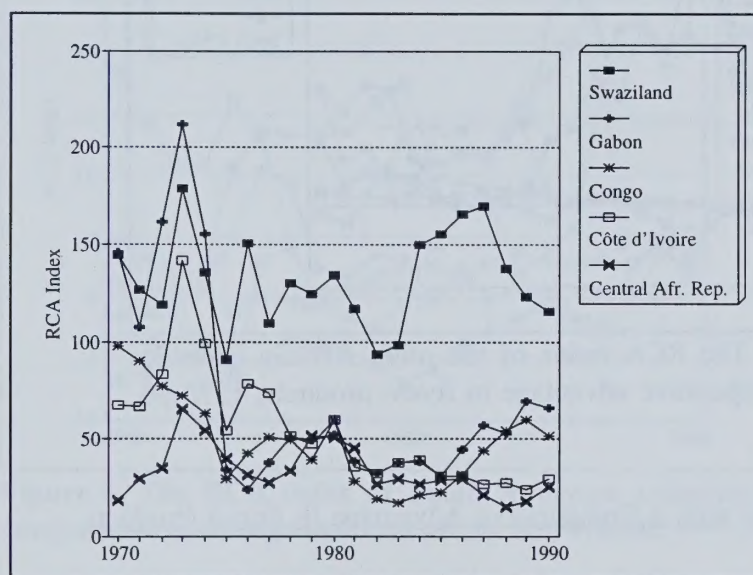
expense of other forest products. In addition, Portugal decreased its dependence on imported paper. Among the countries of Europe and North America with revealed comparative advantages in forest products, apparently only Canada and Norway recorded decreases in the share of net exports of forest products taken up by paper. Is this due to a loss of comparative advantage in these two countries? Paper is certainly, along with wood pulp, the most capital-intensive forest product. It would seem intuitively that industrialized countries that are well endowed with capital should have a comparative advantage here relative to less industrialized countries. It is therefore



curious to see that Canada and Norway did poorly in this area. The theory of comparative advantage would predict that Canada and Norway, which are well endowed with capital, should specialize in paper rather than in other, less lucrative products.

### African Countries with Comparative Advantages in Forest Products

Eleven countries in Africa have comparative advantages in forest products. With the exception of South Africa and Swaziland, which export pulp, the African countries export mostly unprocessed roundwood and lumber (see Table 1). The species that are harvested are usually rare, high-value tropical woods that head for the sawmills and plywood industries of Europe, Japan and the United States.



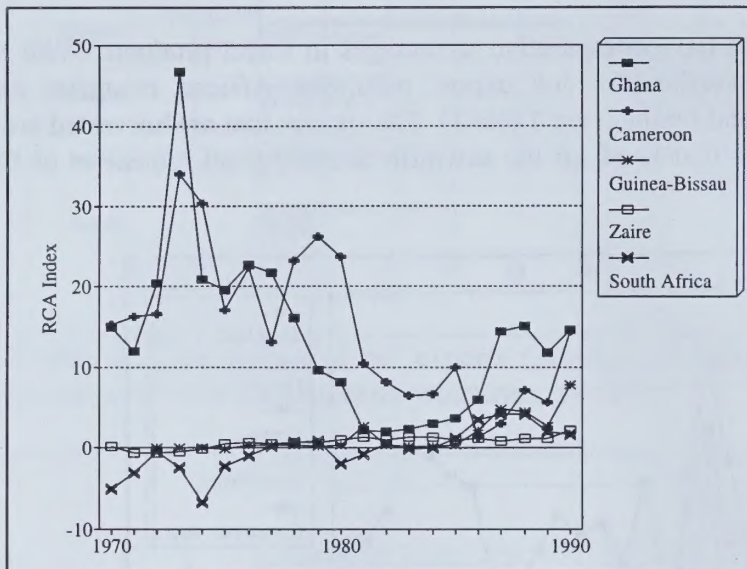
**Figure 4.** RCA index of African countries with a marked comparative advantage in forest products, 1970-90.

Figures 4 and 5 show that the RCA indexes of five African countries—Gabon, the Congo, Côte d'Ivoire, Ghana and Cameroon—collapsed during the 1970s. In the cases of Gabon and the Congo, the decline can be explained by sharply decreased production, while in the other countries, the reduction in prices was apparently responsible for the fall in the value of exports.

Swaziland's enormous revealed comparative advantage stems from a single pulp plant that employs 2 500 people out of a total population of 800 000. This tiny country, surrounded by South Africa, is heavily dependent on international trade. Imports and exports account for 80% of its GNP.

No African country is a net exporter of paper, making the African continent overall an importer.

Apart from the wood pulp produced in South Africa and Swaziland, African forest products do not compete directly with Canadian forest products. Tropical species and the uses they find in the furniture and decoration industries differ from the temperate species in Canada and their use in the construction and paper industries. Trends in the comparative advantages of African countries are therefore of limited interest to the Canadian forest industry.



**Figure 5.** The RCA index of the other African countries with a comparative advantage in forest products, 1970-90.

### Latin American Countries with a Comparative Advantage in Forest Products

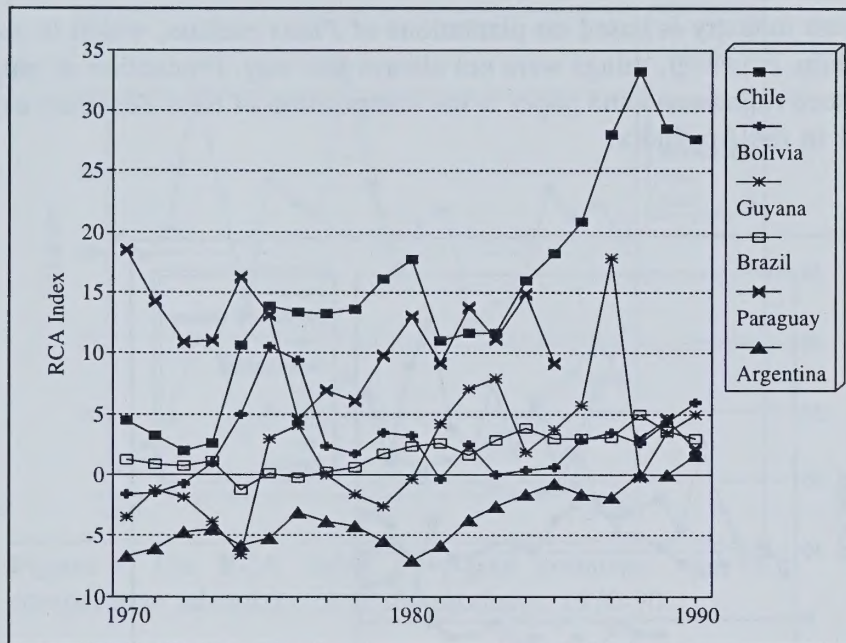
There are six countries in Latin America with a revealed comparative advantage in forest products: Chile, Bolivia, Guyana, Brazil, Paraguay and Argentina. Chile is the country in this region whose RCA index has improved most (see Figure 6). On the basis of its plantations of fast-growing *Pinus radiata*, the Chilean forest industry expanded much more rapidly than the rest of its economy. The pulp wood, lumber and, most especially, wood pulp sectors grew at phenomenal rates. On a world scale, the Chilean forest industry is relatively small; however, net exports of forest products are as important for the Chilean economy as they are for the Canadian economy.

For the other countries in the region, net forest industry exports are much more modest in relation to the rest of the economy. Paraguay's net exports of forest products were higher in the past, but they seem to have been experiencing difficulties for the last few years.<sup>2</sup>

Brazil plays as large a role as Chile on international markets, but since its economy is larger, the forest industry occupies a more modest position within its economy and its RCA index is not so high. Brazil is famous for having the largest tropical forest in the world: the Amazon.



Paradoxically, its forest industry has made only small inroads into it, producing plywood. The wood that the Brazilians harvest is mostly from plantations of *Eucalyptus* trees that supply a pulp and paper industry that is expanding rapidly. Under good conditions, the fast growth of this species makes it possible to harvest it every seven years. Companies frequently plant, wait a few years, and then build a mill when harvesting time approaches—an unthinkable approach in Canada's northern climate.



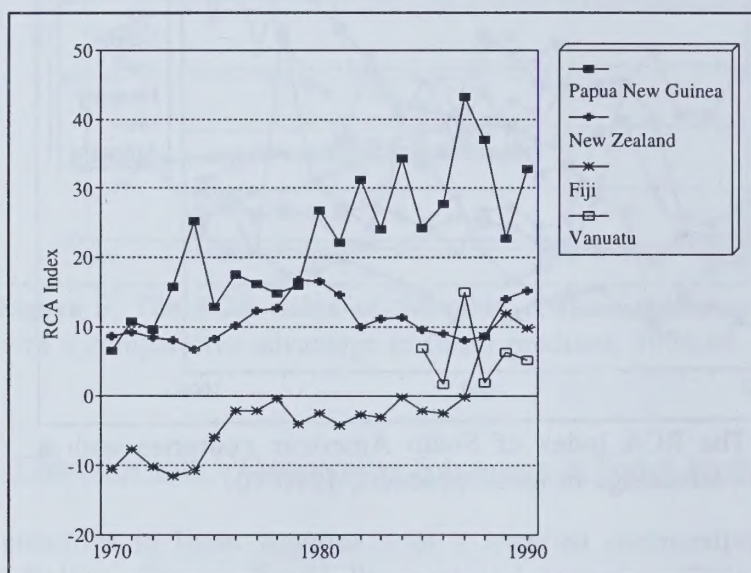
**Figure 6.** The RCA index of South American countries with a comparative advantage in forest products, 1970-90.

Argentina has gone from being a net importer of forest products in the early 1980s to a slightly surplus position in 1990. As in Chile, the Argentinean forest industry has developed thanks to plantations of *Pinus radiata*. Production of pulp wood and wood pulp now exceeds domestic demand. The growth maintained by the Argentinean forest industry during the 1980s was as great as that experienced in Chile during the 1970s. Argentina is a country to watch during the next decade.

## Countries of Oceania and Asia with a Comparative Advantage in Forest Products

The countries of Oceania that have a revealed comparative advantage in forest products are: the Solomon Islands (which are not included in Figure 7), Papua-New Guinea, New Zealand, the Fiji Islands, and Vanuatu (see Figure 7). With the exception of New Zealand, the countries of Oceania export tropical roundwood to be processed elsewhere, particularly in Japan and South Korea.

New Zealand's forest industry is based on plantations of *Pinus radiata*, which is used primarily to produce wood pulp. However, things were not always this way. Production of pulp and panels has gradually replaced roundwood and paper in the composition of New Zealand's exports, as can be seen in Table 1 in the Appendix.



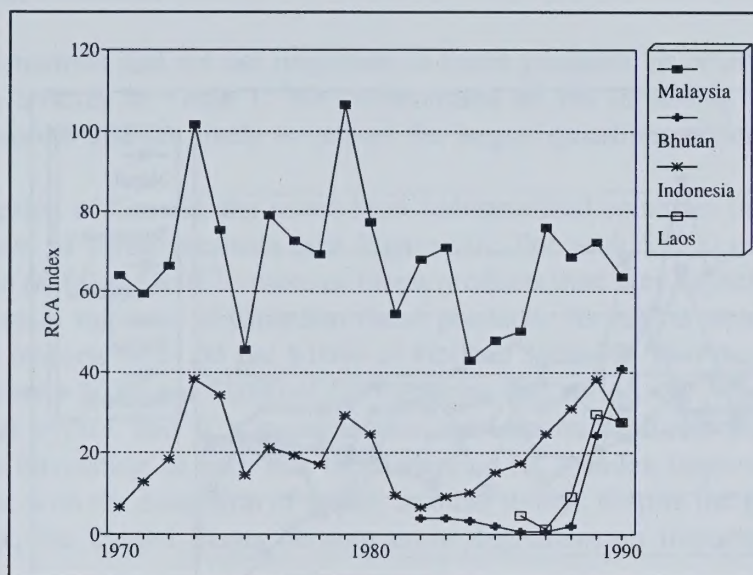
**Figure 7.** The RCA index of countries in Oceania with a comparative advantage in forest products, 1970-90.

The Asian countries that have a revealed comparative advantage in forest products are: Malaysia, Bhutan, Indonesia, Laos (see Figure 8) and the Philippines. Malaysia is clearly the Asian country to which the forest industry is most important. For each \$1000 of GNP, it had \$68 in net average exports of forest products between 1988 and 1990 (see Table 1). Tropical roundwood accounted for two thirds of Malaysia's net exports of forest products. It is declining, however, because it accounted for three quarters of net exports in 1970-72. Malaysian exports of roundwood are gradually being replaced by lumber and plywood.

In Indonesia, Bhutan and Laos, net exports of forest products amounted to about \$30 for each \$1000 of their respective GNPs in 1989 and 1990. However, this revealed comparative advantage



is recent in the cases of Bhutan and Laos. Before 1989, the revealed comparative advantage indexes for these two countries were much lower, when available at all. We will have to wait in order to determine whether these sudden shifts reflect a change in revealed comparative advantages or whether they are a passing statistical error. For the time being, the available data indicate that Bhutan's comparative advantages are in the production of plywood and lumber, while those of Laos are in lumber and roundwood.



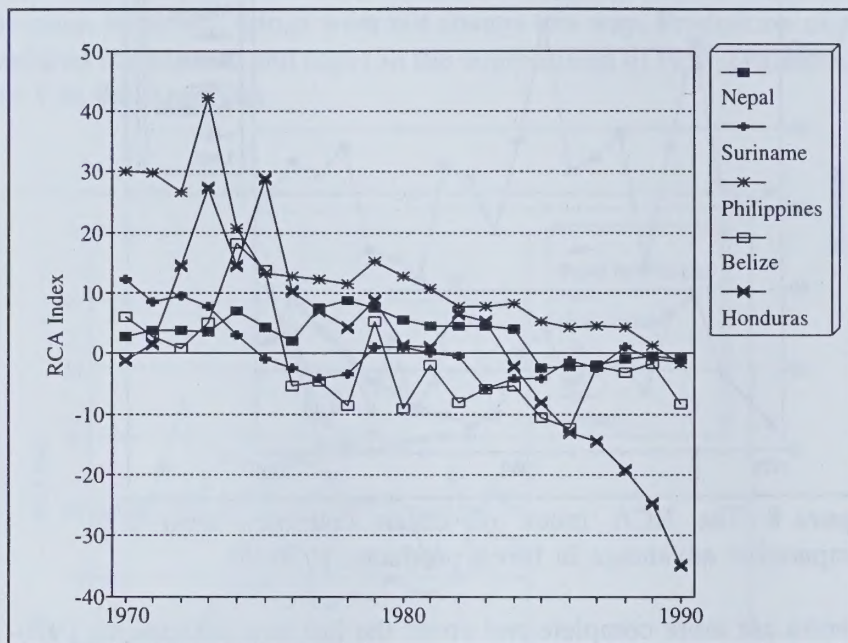
**Figure 8** The RCA index of Asian countries with a comparative advantage in forest products, 1970-90.

The data on Indonesia are more complete and cover the last two decades. In 1970-72, the RCA index was 15.0 for Indonesian roundwood and 0.2 for Indonesian lumber; however, since Indonesia was a net importer of panels and paper, its RCA index for all forest products was 12.5 (see Table 1). In the early 1970s, Indonesia exported its roundwood without any processing. The Indonesian government decided to change this and instituted an industrial development policy. Gradually the door was closed on exports of roundwood in order to encourage domestic processing of this resource. The RCA indexes reported by Bonnefoi and Buongiorno (1990) for the 1982-84 period reflect these changes because they are virtually identical for roundwood (3.2), lumber (3.2) and panels (5.8). Our indexes for 1988-90 show that the about-face is now complete since the roundwood index of 0.4 indicates that Indonesia hardly exports roundwood any more, while it became the world's largest exporter of plywood a few years ago with an RCA index of 27.7 for panels (see Table 1). The change in the composition of exports resulted in the value in real terms (adjusted for inflation) of Indonesia's net exports of forest products increasing by a factor of 9.6, while the harvest increased by only a factor of 2.0.

The Philippines are in a worrisome position. Their revealed comparative advantage index was similar to Canada's in the early 1970s, but then declined to the point of disappearing in the early 1990s. Some conservation groups accuse the forest-product companies operating in the



Philippines of exploiting the forest at a rate that exceeded its ability to regenerate, thus exhausting a resource that is theoretically renewable. The reduction in the harvest over the last two decades tends to show that the Philippine forest is no longer capable of supporting the exploitation levels seen in the past. In the early 1970s, 12 million cubic metres of industrial roundwood were harvested a year, whereas by the last 1980s, only 4 million cubic metres were harvested. From being an exporter, the Philippines have become a net importer of forest products.



**Figure 9.** The RCA index of the countries that lost their comparative advantage in forest products, 1970-90.

The situation in the Philippines is similar to that in Nepal, Surinam, Belize and Honduras. All these countries passed from being net exporters of forest products to net importers. Their situations are not unlike those of a number of African and South American countries whose revealed comparative advantages have suffered serious setbacks over the last few years. In some developing countries, the forest sector is apparently no longer as important as it once was in the economy. It would certainly be interesting to study the reasons for this in order to determine if over-exploitation was responsible. We did not have time, however, to carry out such a study.



### The Main Countries that are Net Importers of Forest Products

After having analysed the revealed comparative advantage indexes of net *exporters* of forest products, that is to say, the indexes of countries that compete with Canada by trying to sell on the same markets, it would be interesting to study net *importers* of forest products and their domestic industries, for often the main competitors of Canadian exporters are domestic industries in the importing countries.

We listed 86 countries that are net importers of forest products, in other words, those that have negative RCA indexes in Table 1. We concentrated on the importing countries that have the strongest economies and are likely to import the largest quantities of forest products.

With the exception of Canada, the seven most industrialized countries (members of the G7) are all net importers of forest products (see Figure 10). For each \$1000 of GNP, these countries import between \$0.60 and \$10.70 more of forest products than they export. The United States has long been the main importer of Canadian forest products. As can be seen in Table 1, the United States had net imports of \$1.00 per \$1000 of GNP in 1970-72. Two decades later, in 1988-90, its net imports were \$0.60 per \$1000 of GNP. During this period, the American RCA index went through several cycles, and it is possible that net imports of forest products will again rise. However, it is interesting to note that the American RCA index improved in all categories of forest products, with the exception of paper. In other words, despite the general improvement in its RCA index, the United States became more dependent on imported paper products (see Table 1).

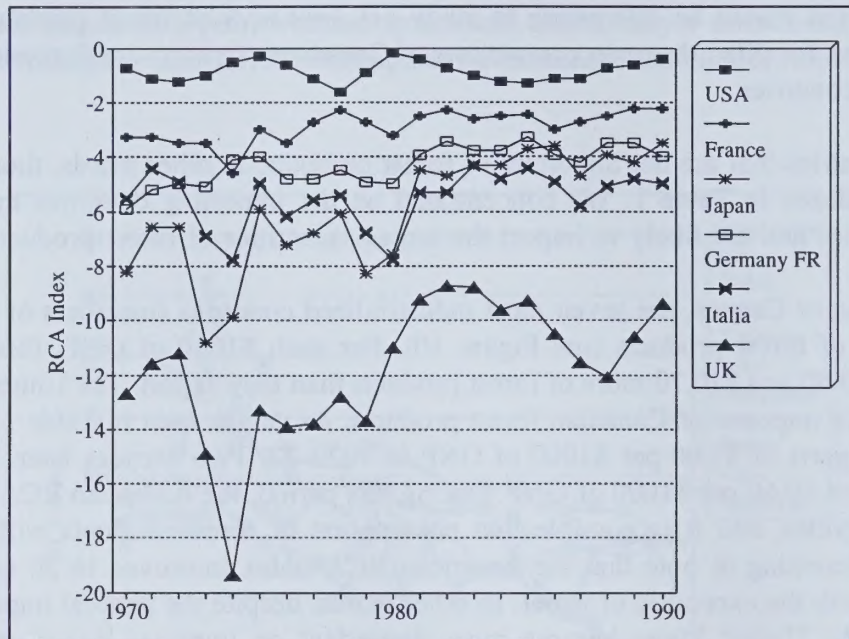
There was a clear reduction in dependence on imported forest products in the economies of the other G7 countries that import forest products, namely Japan, Germany, France, the United Kingdom and Italy (see Figure 10). There could be two reasons for this: first, the consumption of forest products may be increasing less quickly than consumption of other goods and services so that the need for imported forest products per dollar of income declines over time, or second, the forest industry in these countries may be producing more, thus reducing the need for imports. One cannot determine from the RCA index which of these two reasons is the most important.

In 1970-72, Japan was a net importer of roundwood, with an RCA index of -6.6 (see Table 1) and a net exporter of panels and paper. By 1988-90, it had reduced its imports of roundwood but increased its imports of processed forest products. In all, net Japanese imports per dollar of GNP were lower in 1988-90 than in 1970-72. Paper is the only forest product in which Japan is self-sufficient.

The United Kingdom is a large importer of all forest products, with the exception of roundwood, of which it imports only negligible amounts. However, its net imports in comparison with GNP decreased for all forest products with the exception of paper (see Table 1).



The Federal Republic of Germany also improved its RCA index for roundwood, lumber and panels; however, unlike the United Kingdom, its RCA index for pulp increased while that for paper decreased (see Table 1).

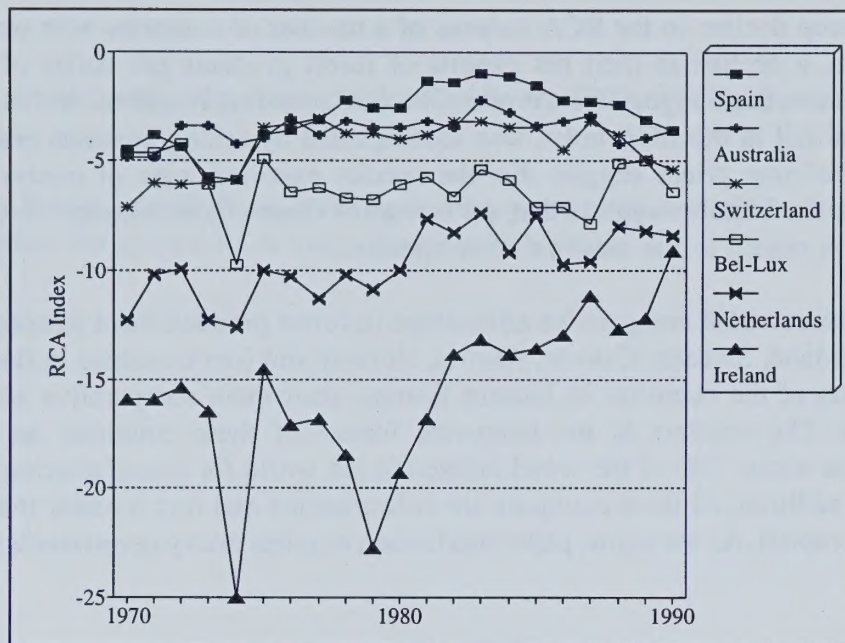


**Figure 10.** The RCA index of the G7 countries that are net importers of forest products, 1970-90.

France has become a net exporter of roundwood, but continues to import processed forest products. It has joined the group of industrialized countries, identified by Bonnefoi and Buongiorno (1990), that have a comparative *disadvantage* in all forest products, but a comparative advantage in roundwood. The other such countries are the United States, Switzerland, Denmark, Ireland and Australia. According to Bonnefoi and Buongiorno, these countries are abandoning processing to other countries, probably because of their high labour costs, and are exporting their roundwood while importing processed forest products. Another possible explanation is that the characteristics of the exported roundwood are not those needed in order to produce the imported products. For instance, the United States might find it advantageous to export its Douglas fir, western hemlock and sequoia to Asian markets and to import black spruce from Canada in the form of newsprint.

The G7 countries that are net importers of forest products have experienced an improvement in their RCA indexes. In other words, they imported fewer forest products in the late 1980s than in the early 1970s per dollar of GNP. The consequence for Canada is that, in future, they will need larger increases in their GNPs in order to generate the same increases in their imports of forest products.





**Figure 11.** The RCA index of the other OECD countries that are net importers of forest products, 1970-90.

Figure 11 shows the RCA indexes of the other OECD countries that are net importers of forest products: Spain, Australia, Switzerland, Belgium-Luxembourg, the Netherlands, Ireland and Denmark. In all these countries, with the exception of Belgium-Luxembourg, net imports of forest products are declining per \$1000 of GNP. In most industrialized countries, imports of forest products are therefore apparently increasing less quickly than the rest of the economy. It is impossible to say at this point whether this is because these countries are developing forest sectors of their own that are substituting for imports, or whether it is because forest products occupy a smaller share of their economies. However Table 1 shows that, in these rich countries, the RCA index for paper is declining and the need for imported paper is mounting.

## DISCUSSION OF THE RESULTS

This study of international trade in forest products using revealed comparative advantage (RCA) indexes uncovers several interesting facts. Of the 37 countries that were identified as having comparative advantages in forest products, 21 have tropical forests. The countries with tropical forests can be divided into two sub-groups: one sub-group of 12 countries that exports its roundwood without processing it and another sub-group of nine countries that exports lumber and wood panels. Since tropical species are not suited for paper production, all these countries (that have data available) are net importers of paper.



We observed a steep decline in the RCA indexes of a number of countries with tropical forests, or in other words, a decline in their net exports of forest products per dollar of GNP. These countries were Gabon, the Congo, Côte d'Ivoire, Ghana, Cameroon, Honduras and the Philippines. In some cases, the fall in the RCA index was accompanied by falling amounts produced, while in other cases, declining prices suggest that the species exported were of poorer quality than previously. The entire picture suggests that the forests of these countries were over-exploited in the past, at least in regard to the most valuable species.

Nine countries with revealed comparative advantages in forest products have temperate, basically natural forests: Finland, Sweden, Canada, Austria, Norway and four countries in Eastern Europe. With the exception of the countries in Eastern Europe, their main comparative advantage is in paper production. The conifers in the temperate forests of these countries are certainly an advantage, because about 70% of the wood utilized in the world for manufacturing paper comes from conifers. In addition, all these countries are industrialized and find it easier than developing countries to raise capital. As we know, paper production requires heavy investments in machinery and equipment.

We also identified seven countries whose RCA indexes are rising quickly and whose success is based on fast-growing plantations, namely, Swaziland, Chile, Portugal, New Zealand, Brazil, South Africa and Argentina. The comparative advantages of all these countries are mainly in wood pulp, and, with the exception of New Zealand and Swaziland, all have improved their comparative advantages in paper production.

In general, the RCA indexes of the main net importers of forest products have improved. In other words, the developed countries are importing fewer forest products than previously for each \$1000 of GNP. However, paper is an exception to this rule since, for the most part, these countries are importing *more* paper per \$1000 of GNP. Most countries with comparative advantages in paper have benefited from this and increased their exports.

Fourteen countries have comparative advantages in the combined sector of pulp and paper. With the exception of four of them, all these countries have increased their comparative advantages in paper to meet the needs of the main countries that are net importers of forest products. The four countries that have not increased their comparative advantages in paper production are Swaziland, Canada, New Zealand and Norway. It is difficult to understand why countries as well endowed with capital and coniferous forests as Canada, New Zealand and Norway have failed to increase their comparative advantages in the paper sector. The determining factors in their comparative advantages would have to be studied in order to answer this question.



Notes:

1. In 1990, or the last base year of this study, Czechoslovakia and Yugoslavia were still single political entities.
2. The data on Paraguay's GNP are missing for the years 1986 and 1987. We were therefore unable to calculate Paraguay's RCA index for these two years.

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Table 1. RCA index of forest products, 1970-72 and 1988-90.

|                             | 1970-72 |               |        |       |       |       | 1988-90 |               |        |       |       |       |
|-----------------------------|---------|---------------|--------|-------|-------|-------|---------|---------------|--------|-------|-------|-------|
|                             | Total   | Round<br>wood | Lumber | Panel | Pulp  | Paper | Total   | Round<br>wood | Lumber | Panel | Pulp  | Paper |
| 1 Eq Guinea                 | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 129,7   | 105,6         | 13,3   | 10,9  | N.A.  | N.A.  |
| 2 Solomon Islands           | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 129,5   | 126,8         | 6,3    | -3,7  | N.A.  | N.A.  |
| 3 Swaziland                 | 129,8   | 2,8           | 18,8   | 4,0   | 104,2 | N.A.  | 125,2   | 0,9           | 17,2   | 2,9   | 104,3 | N.A.  |
| 4 Finland                   | 101,0   | -1,6          | 19,3   | 11,0  | 21,1  | 51,3  | 75,7    | -1,8          | 9,6    | 4,5   | 9,8   | 53,5  |
| 5 Malaysia                  | 63,2    | 48,1          | 16,4   | 5,0   | -0,1  | -6,2  | 68,1    | 42,3          | 26,6   | 9,3   | -0,8  | -9,1  |
| 6 Gabon                     | 138,0   | 112,8         | 1,5    | 24,4  | 0,0   | -0,7  | 62,4    | 54,0          | 0,5    | 9,6   | 0,0   | -1,7  |
| 7 Congo                     | 88,1    | 62,3          | 4,2    | 23,1  | N.A.  | -1,5  | 55,1    | 46,3          | 2,7    | 7,8   | N.A.  | -1,7  |
| 8 Sweden                    | 42,2    | 1,1           | 10,5   | 0,7   | 15,4  | 14,4  | 42,5    | -1,8          | 8,7    | -0,5  | 10,1  | 26,1  |
| 9 Canada                    | 30,5    | 0,2           | 8,8    | 0,3   | 8,3   | 12,8  | 33,0    | 0,3           | 8,9    | 0,6   | 10,9  | 12,4  |
| 10 Indonesia                | 12,5    | 15,0          | 0,2    | -0,1  | 0,0   | -2,6  | 32,2    | 0,4           | 5,8    | 27,7  | -1,7  | -0,1  |
| 11 Papua New Guinea         | 9,0     | 6,6           | 1,9    | 3,0   | N.A.  | -2,5  | 30,8    | 32,1          | 0,4    | 0,0   | N.A.  | -1,6  |
| 12 Chile                    | 3,2     | 0,0           | 0,7    | -0,0  | 1,7   | 0,9   | 29,8    | 7,1           | 6,5    | 0,7   | 14,3  | 1,1   |
| 13 Côte d'Ivoire            | 72,2    | 62,7          | 8,9    | 3,5   | 0,0   | -2,9  | 26,9    | 7,5           | 14,9   | 7,5   | 0,0   | -3,1  |
| 14 Bhutan                   | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 22,2    | 1,1           | 9,8    | 11,3  | N.A.  | N.A.  |
| 15 Laos                     | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 22,0    | 5,5           | 17,1   | 0,0   | N.A.  | -0,5  |
| 16 Central African Republic | 27,4    | 17,2          | 10,8   | 0,0   | N.A.  | -0,6  | 19,2    | 11,6          | 7,2    | 0,6   | N.A.  | -0,2  |
| 17 Portugal                 | 7,3     | -1,3          | 2,8    | 0,9   | 7,0   | -2,0  | 15,5    | -2,4          | 3,1    | 2,8   | 15,0  | -3,1  |
| 18 Ghana                    | 15,7    | 10,9          | 6,5    | 1,0   | N.A.  | -2,8  | 13,8    | 5,6           | 9,0    | 1,8   | N.A.  | -2,6  |
| 19 New Zealand              | 8,8     | 4,7           | 1,3    | 0,1   | 1,3   | 1,3   | 12,6    | 3,2           | 2,1    | 1,8   | 5,4   | 0,1   |
| 20 Austria                  | 15,6    | -1,1          | 10,0   | 1,1   | 0,1   | 5,7   | 12,1    | -1,3          | 4,7    | 1,6   | -0,7  | 7,8   |
| 21 Fiji                     | -9,5    | 0,1           | -3,1   | -2,2  | N.A.  | -4,3  | 10,1    | 10,4          | 3,8    | 2,1   | N.A.  | -6,2  |
| 22 Norway                   | 12,2    | -4,3          | -1,6   | -0,6  | 6,2   | 12,6  | 9,2     | -0,7          | -0,6   | -0,5  | 3,9   | 7,2   |
| 23 Cameroon                 | 16,0    | 13,8          | 2,6    | 2,0   | N.A.  | -2,5  | 9,0     | 8,3           | 2,9    | 1,6   | N.A.  | -3,7  |
| 24 Czechoslovakia           | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 5,0     | 0,5           | 2,7    | -0,1  | 0,6   | 1,2   |
| 25 Guinea-Bissau            | -0,0    | 0,0           | 1,5    | -0,5  | N.A.  | -1,0  | 4,9     | 4,8           | 1,3    | 0,0   | N.A.  | -1,2  |
| 26 Vanuatu                  | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 4,5     | 4,2           | 1,0    | -0,8  | N.A.  | 0,0   |
| 27 Bolivia                  | -1,3    | 0,0           | 1,9    | -0,0  | N.A.  | -3,1  | 4,2     | 0,0           | 4,6    | 0,6   | N.A.  | -0,9  |
| 28 Brazil                   | 0,9     | 0,0           | 1,7    | 0,6   | -0,2  | -1,2  | 3,9     | -0,0          | 0,4    | 0,6   | 1,7   | 1,1   |
| 29 Romania                  | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 3,4     | -0,2          | 2,5    | 0,8   | -1,1  | 1,3   |
| 30 Paraguay                 | 14,5    | 6,3           | 9,4    | 0,8   | N.A.  | -2,0  | 3,2     | 0,0           | 5,3    | 1,8   | N.A.  | -3,9  |
| 31 Guyana                   | -2,2    | 2,3           | 2,7    | -1,0  | N.A.  | -6,2  | 2,7     | 4,1           | 5,0    | -0,1  | N.A.  | -6,3  |
| 32 South Africa             | -3,0    | -0,2          | -1,4   | -0,1  | 1,5   | -2,9  | 2,6     | 0,7           | -0,0   | 0,2   | 2,2   | -0,6  |
| 33 Yugoslavia               | 0,6     | -0,7          | 2,6    | 0,0   | -0,2  | -1,3  | 2,5     | -0,4          | 3,5    | 0,8   | -2,1  | 0,6   |
| 34 Zaire                    | -0,4    | 0,2           | 0,4    | 0,4   | 0,0   | -1,4  | 1,5     | 1,7           | 0,6    | 0,2   | 0,0   | -1,0  |
| 35 Philippines              | 28,8    | 25,9          | 1,5    | 4,9   | -0,8  | -2,8  | 1,4     | -0,2          | 2,7    | 1,9   | -0,7  | -2,8  |
| 36 Poland                   | N.A.    | N.A.          | N.A.   | N.A.  | N.A.  | N.A.  | 1,3     | 0,4           | 1,0    | 0,6   | -0,7  | 0,0   |
| 37 Argentina                | -5,9    | -0,3          | -2,2   | -0,0  | -1,2  | -2,2  | 0,5     | 0,5           | -0,3   | 0,1   | 0,5   | -0,2  |
| 38 São Tomé and Príncipe    | -0,4    | 0,0           | 0,0    | -0,4  | N.A.  | 0,0   | 0,0     | 0,0           | 0,0    | 0,0   | N.A.  | 0,0   |
| 39 Suriname                 | 10,0    | 0,9           | 2,9    | 12,3  | N.A.  | -6,1  | -0,5    | 0,6           | 0,2    | 1,3   | N.A.  | -2,6  |
| 40 USA                      | -1,0    | 0,3           | -0,5   | -0,3  | -0,1  | -0,5  | -0,6    | 0,5           | -0,2   | -0,1  | 0,1   | -0,9  |
| 41 Uganda                   | -1,9    | 0,0           | 0,1    | -0,5  | N.A.  | -1,4  | -0,7    | 0,0           | -0,0   | -0,0  | N.A.  | -0,7  |
| 42 Nepal                    | 3,3     | 3,1           | 0,2    | N.A.  | N.A.  | 0,0   | -0,7    | 0,1           | 0,0    | N.A.  | N.A.  | -0,8  |
| 43 Ethiopia                 | -1,8    | 0,0           | -0,0   | -0,1  | 0,0   | -1,1  | -0,8    | 0,0           | 0,0    | -0,1  | -0,5  | -0,3  |



|                 | Total | Round | Lumber | Panel | Pulp | Paper | Total | Round | Lumber | Panel | Pulp | Paper |
|-----------------|-------|-------|--------|-------|------|-------|-------|-------|--------|-------|------|-------|
|                 | wood  |       |        |       |      |       | wood  |       |        |       |      |       |
| 44 Mauritania   | 0,0   | N.A.  | 0,0    | 0,0   | N.A. | N.A.  | -0,9  | N.A.  | -0,6   | -0,2  | N.A. | N.A.  |
| 45 Mali         | -1,4  | N.A.  | -0,4   | -0,1  | N.A. | -0,9  | -0,9  | N.A.  | -0,5   | -0,1  | N.A. | -0,4  |
| 46 Bangladesh   | -0,3  | 0,0   | -0,0   | N.A.  | -0,6 | 0,3   | -1,1  | -0,5  | -0,1   | N.A.  | -0,4 | -0,1  |
| 47 India        | -0,6  | 0,1   | -0,0   | 0,0   | -0,2 | -0,6  | -1,1  | -0,4  | -0,0   | 0,0   | -0,2 | -0,6  |
| 48 Zimbabwe     | 0,0   | 0,0   | 0,0    | 0,0   | 0,0  | 0,0   | -1,1  | 0,0   | 0,4    | 0,1   | -0,4 | -1,2  |
| 49 Sierra Leone | -2,3  | -0,1  | -0,1   | -1,3  | N.A. | -0,8  | -1,2  | 0,0   | 0,2    | -0,4  | N.A. | -1,0  |
| 50 Benin        | 0,0   | 0,0   | 0,0    | 0,0   | N.A. | 0,0   | -1,3  | 0,0   | -0,0   | -0,1  | N.A. | -1,2  |
| 51 Rwanda       | -0,7  | N.A.  | -0,7   | 0,0   | N.A. | 0,0   | -1,4  | N.A.  | -0,0   | -0,4  | N.A. | -0,9  |
| 52 Singapore    | -7,6  | -13,5 | 11,1   | 6,8   | -0,1 | -11,9 | -1,4  | -0,3  | 4,4    | 2,8   | 0,0  | -8,6  |
| 53 Madagascar   | -1,8  | 0,1   | -0,0   | -0,6  | -0,5 | -0,8  | -1,7  | 0,1   | -1,0   | -0,0  | 0,0  | -0,8  |
| 54 Togo         | -1,8  | 0,0   | -0,8   | -0,4  | N.A. | -0,5  | -1,8  | -0,1  | -0,3   | -0,1  | N.A. | -1,2  |
| 55 Burundi      | -0,1  | N.A.  | N.A.   | -0,1  | N.A. | 0,0   | -1,9  | N.A.  | N.A.   | -0,2  | N.A. | -1,7  |
| 56 Mexico       | -1,6  | -0,0  | -0,1   | -0,0  | -0,5 | -0,9  | -1,9  | -0,0  | -0,1   | -0,1  | -1,0 | -0,7  |
| 57 Zambia       | -5,2  | -0,1  | -1,4   | -0,9  | N.A. | -2,7  | -2,1  | 0,0   | -0,0   | -0,0  | N.A. | -2,0  |
| 58 Uruguay      | -4,7  | -0,3  | -1,3   | -0,1  | -1,1 | -1,8  | -2,1  | -0,0  | -0,7   | -0,1  | -0,6 | -0,7  |
| 59 Iran         | -4,7  | -0,1  | -0,7   | -0,2  | -0,2 | -3,5  | -2,2  | -0,1  | -0,2   | -0,1  | -0,1 | -1,6  |
| 60 Chad         | -4,7  | N.A.  | -2,1   | 0,0   | N.A. | -2,6  | -2,3  | N.A.  | 0,0    | 0,0   | N.A. | -2,3  |
| 61 France       | -3,4  | -0,5  | -0,5   | 0,1   | -1,2 | -1,2  | -2,3  | 0,2   | -0,4   | -0,1  | -1,0 | -1,0  |
| 62 Kenya        | -8,9  | 0,0   | 0,2    | -0,8  | N.A. | -9,0  | -2,5  | 0,0   | 0,0    | -0,1  | N.A. | -2,4  |
| 63 Burkina Faso | -1,1  | 0,0   | -0,5   | -0,2  | N.A. | -0,4  | -2,5  | 0,0   | -0,9   | -0,3  | N.A. | -1,3  |
| 64 Somalia      | -2,0  | 0,0   | -0,4   | -0,1  | N.A. | -1,5  | -2,6  | -0,0  | -0,1   | -0,0  | N.A. | -2,5  |
| 65 Nigeria      | -1,8  | 0,5   | 0,2    | 0,0   | -0,1 | -2,4  | -2,7  | 0,0   | 0,2    | -0,1  | -0,1 | -2,8  |
| 66 Niger        | -0,6  | 0,0   | 0,0    | -0,2  | N.A. | -0,4  | -2,9  | 0,0   | -0,4   | -0,7  | N.A. | -1,7  |
| 67 Gambia, The  | -1,2  | 0,0   | -0,2   | -1,0  | N.A. | -0,0  | -2,9  | 0,0   | -0,6   | -0,9  | N.A. | -1,5  |
| 68 Spain        | -4,2  | -1,0  | -1,4   | 0,2   | -1,2 | -0,8  | -3,0  | -0,6  | -1,1   | 0,0   | 0,2  | -1,6  |
| 69 El Salvador  | -10,6 | -0,0  | -1,1   | -1,1  | -0,1 | -8,3  | -3,1  | -0,0  | -1,2   | -0,3  | 0,0  | -1,6  |
| 70 Colombia     | -2,7  | -0,0  | 0,6    | 0,0   | -1,0 | -2,3  | -3,3  | 0,0   | -0,0   | 0,0   | -0,8 | -2,5  |
| 71 Libya        | -3,9  | -0,3  | -2,4   | -0,7  | N.A. | -0,5  | -3,4  | -0,4  | -1,2   | -0,9  | N.A. | -0,9  |
| 72 Tanzania     | -2,7  | 0,0   | 0,4    | -0,3  | N.A. | -2,7  | -3,5  | 0,0   | 0,7    | 0,0   | N.A. | -4,3  |
| 73 Mozambique   | N.A.  | N.A.  | N.A.   | N.A.  | N.A. | N.A.  | -3,6  | 0,9   | 0,1    | 0,1   | N.A. | -4,6  |
| 74 Bulgaria     | N.A.  | N.A.  | N.A.   | N.A.  | N.A. | N.A.  | -3,6  | -0,0  | -0,5   | 0,2   | -1,6 | -1,7  |
| 75 Pakistan     | -1,8  | -0,6  | -0,3   | -0,1  | -0,1 | -0,7  | -3,6  | -0,1  | -0,1   | -0,0  | -0,4 | -3,0  |
| 76 Saudi Arabia | -4,5  | -1,1  | -1,6   | -0,5  | N.A. | -1,3  | -3,6  | -0,1  | -1,1   | -1,4  | N.A. | -1,0  |
| 77 Turkey       | -1,3  | 0,1   | 0,2    | 0,0   | -0,4 | -1,1  | -3,6  | -1,1  | 0,1    | -0,0  | -1,1 | -1,5  |
| 78 Germany, FR  | -5,4  | -0,7  | -1,5   | -0,4  | -1,3 | -1,6  | -3,7  | -0,0  | -1,0   | -0,2  | -1,9 | -0,8  |
| 79 Haiti        | -3,3  | 0,0   | -1,4   | 0,0   | N.A. | -2,0  | -3,9  | 0,0   | -1,2   | 0,0   | N.A. | -2,6  |
| 80 Japan        | -7,1  | -6,6  | -0,7   | 0,3   | -0,6 | 0,4   | -3,9  | -1,9  | -0,9   | -0,4  | -0,7 | 0,0   |
| 81 Australia    | -4,3  | 0,2   | -1,2   | -0,1  | -0,9 | -2,3  | -3,9  | 1,2   | -1,3   | -0,2  | -0,7 | -2,8  |
| 82 Peru         | -2,6  | -0,0  | -0,2   | 0,1   | -0,7 | -1,7  | -3,9  | -0,0  | 0,1    | 0,0   | -1,6 | -2,4  |
| 83 Venezuela    | -3,5  | -0,0  | -0,1   | -0,1  | -1,3 | -2,1  | -4,1  | -0,0  | -0,0   | -0,0  | -2,0 | -2,1  |
| 84 Malawi       | -7,0  | 0,1   | -1,4   | -1,8  | N.A. | -3,9  | -4,3  | 0,0   | 0,1    | -0,0  | N.A. | -4,4  |
| 85 Belize       | 3,2   | 0,6   | 16,0   | -2,5  | N.A. | -10,9 | -4,4  | 2,2   | 3,0    | -4,1  | N.A. | -5,5  |
| 86 Syria        | -5,9  | -0,9  | -3,0   | -0,0  | N.A. | -2,0  | -4,4  | -0,4  | -0,4   | -0,1  | N.A. | -3,5  |
| 87 Switzerland  | -6,4  | -0,5  | -1,2   | -0,9  | -1,5 | -2,3  | -4,7  | 0,1   | -1,1   | -0,7  | -1,1 | -1,9  |
| 88 Italy        | -4,9  | -1,3  | -2,1   | 0,4   | -1,8 | -0,1  | -5,0  | -0,7  | -1,7   | -0,1  | -1,6 | -0,8  |
| 89 Guatemala    | -3,8  | 0,0   | 0,7    | -0,0  | -0,8 | -3,7  | -5,4  | 0,6   | 0,7    | 0,1   | -0,2 | -6,5  |



1970-72

1988-90

|                         | Total | Round<br>wood | Lumber | Panel | Pulp | Paper | Total | Round<br>wood | Lumber | Panel | Pulp | Paper |
|-------------------------|-------|---------------|--------|-------|------|-------|-------|---------------|--------|-------|------|-------|
| 90 Bel-Lux              | -4,5  | -0,8          | -2,0   | 1,0   | -1,6 | -1,0  | -5,5  | -0,2          | -1,9   | 1,3   | -1,3 | -3,3  |
| 91 Oman                 | 0,0   | 0,0           | 0,0    | 0,0   | N.A. | 0,0   | -5,5  | -0,6          | -1,9   | -1,6  | N.A. | -1,5  |
| 92 Senegal              | -4,5  | -0,9          | -0,5   | -0,4  | N.A. | -2,6  | -6,8  | -0,5          | -0,9   | -0,9  | N.A. | -4,5  |
| 93 China                | 0,5   | -0,6          | 0,3    | 1,0   | -0,2 | -0,1  | -6,9  | -2,7          | -0,6   | -1,0  | -1,4 | -1,3  |
| 94 Algeria              | -9,2  | -0,4          | -5,0   | -1,2  | -0,1 | -2,5  | -6,9  | -0,7          | -3,0   | -0,4  | -0,8 | -2,1  |
| 95 Israel               | -9,3  | -1,7          | -3,2   | 0,8   | -1,4 | -3,7  | -7,1  | -0,8          | -1,7   | 0,1   | -1,2 | -3,5  |
| 96 Cape Verde           | -6,6  | 0,0           | -4,4   | -0,6  | N.A. | -1,1  | -7,2  | 0,0           | -2,4   | -2,3  | N.A. | -2,5  |
| 97 Hungary              | N.A.  | N.A.          | N.A.   | N.A.  | N.A. | N.A.  | -7,4  | 0,8           | -1,8   | -0,4  | -3,4 | -2,8  |
| 98 Morocco              | -5,8  | -1,9          | -2,9   | -0,1  | 0,6  | N.A.  | -8,0  | -2,3          | -4,0   | -0,1  | 1,1  | N.A.  |
| 99 Netherlands          | -10,8 | -0,7          | -4,8   | -1,5  | -2,8 | -1,0  | -8,2  | -0,2          | -3,0   | -2,0  | -1,9 | -1,1  |
| 100 Thailand            | -2,3  | 0,6           | 0,7    | 0,0   | -0,9 | -2,5  | -8,8  | -2,2          | -2,4   | 0,2   | -1,2 | -3,1  |
| 101 Costa Rica          | -18,4 | 0,0           | -0,2   | 0,6   | -0,5 | -18,4 | -9,1  | 0,1           | 0,1    | 0,8   | -0,2 | -9,9  |
| 102 Korea, Republic of  | -4,2  | -14,1         | 0,1    | 14,0  | -3,3 | -0,8  | -9,4  | -5,2          | -0,5   | -0,7  | -3,4 | 0,4   |
| 103 Sri Lanka           | -4,2  | -0,0          | 0,0    | -0,9  | -0,4 | -3,0  | -9,7  | 0,0           | -0,2   | -1,3  | -0,5 | -7,7  |
| 104 Samoa               | N.A.  | N.A.          | N.A.   | N.A.  | N.A. | N.A.  | -10,4 | 0,0           | -3,0   | -1,1  | N.A. | -6,3  |
| 105 United Kingdom      | -11,8 | -0,2          | -3,9   | -1,8  | -3,0 | -2,8  | -10,7 | -0,0          | -2,8   | -1,4  | -1,6 | -4,8  |
| 106 Jordan              | N.A.  | N.A.          | N.A.   | N.A.  | N.A. | N.A.  | -10,8 | -0,0          | -1,3   | -2,2  | N.A. | -7,2  |
| 107 Ireland             | -15,8 | -0,3          | -6,9   | -0,2  | -1,6 | -6,7  | -11,3 | 0,4           | -1,8   | 0,2   | -0,5 | -9,5  |
| 108 Panama              | -13,0 | -0,1          | -0,9   | -0,5  | -0,4 | -11,1 | -11,5 | -0,2          | -0,2   | 0,0   | -0,2 | -11,0 |
| 109 Iceland             | -18,4 | -0,4          | -7,2   | -3,9  | N.A. | -6,8  | -11,5 | -0,1          | -3,0   | -2,7  | N.A. | -5,7  |
| 110 Ecuador             | -11,7 | 0,0           | 2,1    | -0,3  | -0,0 | -13,4 | -11,5 | 0,0           | 1,4    | 0,9   | -1,2 | -12,6 |
| 111 Trinidad and Tobago | -16,1 | -0,1          | -3,7   | -1,3  | 0,0  | -10,9 | -11,6 | -0,0          | -1,7   | -1,4  | -0,3 | -8,2  |
| 112 Bahamas, The        | 0,3   | 11,9          | -6,7   | -2,8  | N.A. | -2,1  | -12,6 | -0,3          | -4,1   | -3,1  | N.A. | -5,1  |
| 113 Tunisia             | -6,0  | -0,9          | -3,7   | -0,2  | -0,4 | -3,0  | -12,7 | -0,1          | -6,6   | -0,9  | -1,4 | -4,6  |
| 114 Denmark             | -13,1 | -0,4          | -4,3   | -1,7  | -0,5 | -6,3  | -12,9 | 0,1           | -3,1   | -1,3  | -0,6 | -8,1  |
| 115 Greece              | -7,8  | -1,3          | -2,8   | -0,0  | -1,6 | -2,1  | -12,9 | -1,7          | -2,9   | -0,5  | -1,9 | -6,0  |
| 116 Cyprus              | N.A.  | N.A.          | N.A.   | N.A.  | N.A. | N.A.  | -12,9 | -0,0          | -3,3   | -2,3  | -0,2 | -7,1  |
| 117 Mauritius           | -7,3  | -0,2          | -2,3   | -1,6  | N.A. | -3,2  | -13,4 | -1,2          | -2,3   | -2,3  | N.A. | -7,6  |
| 118 Dominican Republic  | -9,5  | 0,0           | -5,0   | -0,4  | -0,6 | -3,5  | -13,9 | -0,5          | -3,2   | -0,8  | -0,2 | -9,2  |
| 119 Hong Kong           | -21,0 | -2,0          | -0,5   | -2,5  | 0,0  | -15,7 | -16,0 | -0,7          | -0,2   | -2,3  | -0,1 | -12,8 |
| 120 Malta               | -17,6 | -0,1          | -6,1   | -3,4  | N.A. | -8,0  | -16,4 | -0,1          | -3,0   | -1,3  | N.A. | -12,0 |
| 121 Jamaica             | -15,7 | -0,5          | -5,3   | -1,1  | N.A. | -8,8  | -20,0 | -0,0          | -3,9   | -2,1  | N.A. | -13,9 |
| 122 Tonga               | N.A.  | N.A.          | N.A.   | N.A.  | N.A. | N.A.  | -21,7 | N.A.          | -16,0  | -5,7  | N.A. | N.A.  |
| 123 Honduras            | 5,0   | 0,9           | 24,7   | -0,3  | N.A. | -20,3 | -26,3 | 3,1           | 6,4    | -0,3  | N.A. | -35,6 |
| 124 Egypt               | -7,1  | -0,3          | -3,3   | -0,4  | -1,1 | -2,0  | -55,1 | -2,1          | -26,6  | -6,1  | 0,0  | -20,3 |







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| 33. S.E. Phelps                                         | The PELPS III Report Generator for the North American Pulp and Paper Model (NAPAP).<br>TECHNICAL DOCUMENTATION                                      | September 1993 |
| 34. Romain Jacques,<br>Darcie Booth and<br>Susan Phelps | The Economic Impacts of U.S. Recycled Fibre Content<br>Legislation on the Canadian Newsprint Industry.                                              | October 1993   |
| 35. Jennifer Beverly and<br>Tim Williamson              | Wildland Fire Management Economics: Post 1982<br>Literature Review and Bibliography                                                                 | November 1994  |
| 36a. Romain Jacques                                     | Les avantages comparatifs révélés dans le commerce<br>des produits forestiers                                                                       | Novembre 1994  |
| 36b. Romain Jacques                                     | Revealed Comparative Advantage in Forest Products<br>Trade                                                                                          | February 1995  |
| 37. Jérôme Catimel                                      | Sensitivity of the Competitiveness of the Canadian Pulp<br>and Paper Industry to Environmentally Related Shocks<br>to Roundwood Supply <sup>1</sup> | December 1994  |





